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ABSTRACT

Agri-food supply chains are at the heart of sustainable development concerns. In order to comprehend whole complex parameters and their global impacts, it appeared necessary to adopt a systemic approach, justifying a Life Cycle Assessment (LCA), not only from an environmental point of view but from a social and economic one too. Taking into account specificities and stakes of fruits and vegetables (F&V) supply chains in developing countries this paper focus on absences, deficiencies and methodological limits that LCA meets integrating social and economic aspects. The elements presented lead to an in-depth conceptual and theoretical discussion and suggest placing LCA in the perspective of development theory. The proposition is to endow LCA with an approach "by capitals", which seems particularly adapted to express sustainable development and well-being.

Keywords: social LCA, fruit & vegetables, sustainability, multiple capital model,

1. Background

Agri-food supply chains are at the heart of sustainable development concerns. It's particularly true from an environmental point of view due to off-season productions, remote localization away from consumption areas and culture intensification. These elements question productions models, in particular technologies of production and their localization, in terms of resource depletion, water, soil and air contamination, global warming, etc. Life Cycle Assessment (LCA) appeared particularly well adapted to consider whole complex parameters and their global impacts. Its initial goal was to assess a full range of potential environmental impacts related to products and services, in order to choose the best alternative or to improve its (Jolliet et al. 2004). Nevertheless, sustainability doesn't end in environmental dimension, even if it's a very important component. It includes (at least) social and economic dimensions (WCED 1987). To evaluate social and economic impacts presents similar interests as environmental-LCA, in terms of capacity of comparison of products or services and identification of hotspot and margin of improvement. In addition, this integration seems particularly important in a global sustainability assessment prospect, due to the strengthening of societal expectations towards agri-food products, tending to change the modes of governance of these supply chains as well as their organization, and to reinforce social standards. In this context, integrating socio-economic aspects in decision criteria is essential. To consider these aspects is all the more reason important for horticultural products which are source of significant social and economic impacts, in particular in developing countries where horticultural products greatly contribute to the GDP (Weinberger et al. 2005). To consider the specific case of F&V supply chains in these countries could enrich the discussion on Social LCA (S-LCA), highlighting through their specificities and stakes the important elements that need to be taken into account in a framework.

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2. Social and economic implications of F&V supply chains: specificities & stakes

Rising per capita income, urbanization, changes in consumer taste and globalization is changing consumption behaviour, consequently worldwide supply and international trade in F&V (Weiberger 2005, Temu et al. 2005). Many developing countries took advantage of these changes and have diversified into horticultural crop production and exports based on favourable climatic conditions and lower labour costs (Davis 2005). Effectively, horticultural products are considered as High Value Agricultural Products (HVAP), defined as a "product that return a higher gross margin per unit of available resources (land, labour, capital, human capacities) than other product within a given location and context" (GFAR 2005), offering an opportunity for rural poor to improve their livelihoods.

Horticultural products have some comparative advantages in comparison to others productions. They are source of high profitability for farmers in terms of net farm incomes and net returns on different input measures (McMulloch et al. 2002). For example, in Kenya net farm incomes were five times higher per family member compared to smallholder farmers who did not grow horticultural products (McCulloch et al. 2002). Furthermore, these products generate additional employment opportunities in rural areas because they are more labour intensive than the production of staple crops. For example, horticultural production requires nearly three times more labour than cereal crops (Weiberger et al. 2005). Requiring specialized inputs both upstream and downstream, the growth in HVAP induces a multiplier effect in terms of economic activities and employment potential generation. Horticultural sub-sector generates less tangible and indirect benefits. It contributes to the institutional environment development, in particular for access to credit and capital since the crops are more risky and costly than others (Weiberger et al. 2005). International markets need to comply with a range of legal and commercial standards (maximum residue level of pesticides, phytosanitary certificate, traceability, good agricultural practice) (Temu et al. 2005), which contributes to the determining of norms, labels, codes, etc. They encourage development of networks and market organizations (supply chains, market price information, etc.). It's a major factor in infrastructures investments like roads, rails, seaport, electrification, wastewater system, etc. Being sophisticated products, they require qualified employees, consequently high level of knowledge and skills reached thanks to training and formation.

In compensation, there are some negative impacts. International market development goes with pernicious effects. There aren't technical economies of scale (Temu et al. 2005), but legal and commercial requirements to access to these markets are very important. So that, only organized small-scale farmers or large-scale enterprises are able to comply with (Temu et al. 2005). It means that most private small-scale farmers are kept away from benefits of this developing sector and consequently from an opportunity of development. For example, in India, population still suffers from malnutrition whereas the country is one on the more important producer of basmati rice (Rahnema 2002). Moreover activities concentration and wealth appropriation by few actors is often synonym of capital flight for favourable taxation places. Attractive and lucrative character of HVAP (Dolan et al. 1999 could create a competition for land and resources with local production and food-producing. Accesses to international market and adaptations to satisfy developed countries expectations involve adoption of skills and technologies imported that could destroy knowledge and know-how (Rahnema 2002). These adaptations could change dramatically lifestyles and cause disruptions in local population habits, imitating northern functioning and rubbing local specificities. Working conditions, safety and workers rights are not always respected. Child labour is certainly the principal critical point, even if the perception of child labour is different depending on the place in the

world. For example, in banana cropping, "deflowering" is a task entrusted to children after school in Latin America, allowing them to contribute to family incomes. It cannot be considered in West French Indies.

The stakes subtended by the development of horticultural productions in developing countries are poverty alleviation and economic development. It's therefore important, not to say necessary, to be able to assess for example the difference between two organization modes, namely an integrated system (promoted by high accessing costs to international markets) and an atomized small-scale farmers system. Moreover, in a globalized world, where sustainable criteria will become access market barriers and criteria of decision for sourcing, it's essential not only to discriminate alternatives thanks to environmental elements but also to include all the complex aspects presented previously. That is the whole issue of S-LCA development.

3. Ambiguities and absences in the scope of social and economic aspects integration

Social LCA no longer needs to be justified (Griebhammer et al. 2006). In terms of methodology, it was highlighted that there were evidently no fundamental problems even if considerable hurdles needed to be overcome in practice, especially in characterization modeling (Griebhammer et al. 2006). In spite of efforts to find an international consensus on the general principles (UNEP/ SETAC 2009), literature shows a wide range of frameworks with many differences (choice of indicators, impacts categories, characterization factors, etc.). Despite the Task Force preferred to put the emphasis on methodological hurdles, considering some absences, deficiencies or methodological limits, this article asks the question of the analysis and the evolution of LCA conceptual and theoretical framework in the view of a broader sustainable conception, integrating environmental, social and economic aspects.

3.1. A fuzzy conceptual framework

The first level of explication could concern the conceptual framework. Most of works deal with methodology rather than conceptual framework, whereas it appears essential and could explain a lot of deadlocks. Thus, a state of art of existing works on S-LCA highlighted some fuzzy and ambiguities on goals, extent, content and boundaries, and upstream on what is important to protect from a societal point of view (Areas of Protection). While the guidelines for S-LCA of UNEP/ SETAC (2009) declare that "social LCA will be used as a synonym for social and socio-economic LCA", most of the authors make a clear distinction between economic impacts -assessed by Life Cycle Cost- and social impacts -the real object of S-LCA (Norris 2001, Klöpffer 2003, Dreyer 2006, Hunkeler 2006, Hutchins 2008), letting the real content of S-LCA vague. Yet, the will to integrate socio-economic aspects in LCA involves referring to human-being and the society in which he evolves, and its attributes (e.g. norms, rules, public utility, etc). Nevertheless, excepted in Jorgensen et al. (2010), the AoP relating to Human life as presented in the different framework do not differentiate clearly the individual dimension of human well-being from the societal dimension. In addition the position of "less tangible items of financial and cultural values" in the "man-made environment" AoP's seems not so relevant, considering the original definition of the AoP, that is to say elements that change land surfaces for human purposes (Jolliet et al. 2004). Financial items don't change land surface except indirectly through investment. Cultural values (e.g. languages or practices), with a broader conception than the "value of unique landscape and unique archaeological sites" (Weidema 2001), refer more to the societal dimension of Human life AoP than to the man-made environment.

3.2. Limited theoretical foundations

The second level of explication for methodological limits but also for conceptual ambiguities could refer to the subjacent theoretical model. LCA was originally an engineering counting method, "for evaluating the opportunities, risks, and trade-offs associated with products and services over their entire life cycle" (UNEP/SETAC 2009). By its empirical approach, it developed itself without clear theoretical foundations, apart from the fact that it was in line with sustainable development model like defined by WCED (1987). On time to integrate social and economic aspects, LCA confronted two hurdles. First, the discussions about S-LCA have concerned the categorization and classification of indicators. Nevertheless, social and economic aspects being particularly complex from one hand and the theoretical framework being not sufficiently explicit from another hand, this lead to draw up a large inventory of indicators without neither being able to produce a synthesis nor putting them into perspective. This limitation is in contradiction with the operational goal attribute to LCA which is "to evaluate trade-offs associated with products and services" (UNEP/SETAC 2009). In second point, S-LCA works give a partial view of social and economic aspects. The Life Cycle Initiative specified the main criticisms made to this method. In particular they could be seen "to be 'anti-development'-orientated because it provides only a picture of negative environmental consequences, but does not reflect any of the positive aspects of development; and to not address the developing countries most significant concerns" (UNEP/SETAC 2009). These critics reinforce the idea that the model of sustainable development which underlies S-LCA actual frameworks doesn't identify sufficiently human, social and institutional dimensions, as it was suggested previously as regards the consideration of the content of human AoP. This limitation is in contradiction with the conceptual goal attributed to LCA, which is "to achieve sustainable development" (UNEP/SETAC 2009).

3.3. Methodological limitations resulting

This double level of incompleteness and fuzziness results in absences and deficiencies at methodological level. The main deficiency concerns the distinction between well-being and sustainability from one hand, and between flow and stock from another hand. They aren't clearly expressed and developed, and yet they are crucial. According to Stiglitz et al. (2009) sustainability asks the question to know if it's possible to expect that actual well-being level could be at least maintained for future generations or periods. The notions of flow and stocks are required here, in the sense that future well-being will depend on their fluctuations, since sustainability needs a minimum and constant stock of "wealth". Wealth is understood in a broader sense which doesn't limit to natural resources but includes other forms of capital, in particular human, social and physical capital. To make the difference between well-being and sustainability - involving different temporal scales and different stakeholders with a specific reference to future generations – one needs to consider the assessment through a dynamic approach. Moreover, the difference between flow and stock involves the notion of depletion and irreversibility of "wealth/resources" consumption or destruction. Consequently, the depletion of all kind of capital by a productive process needs to be considered as a reduction of stock and not as an income. It's the case for productive capital considering depreciation mechanism, which immobilizes a value equivalent to the part of technical capital destroyed in the process of production in order to offset the loss of capital. But it's not the same thing for all capital forms. Others limitations concern the consideration of hidden costs (not only direct effects), positive impacts (not only damages), economic price (not only financial price). We will not develop these aspects in this communication.

4. Conclusion: a new theoretical framework

All elements presented previously involve to strike up a deep discussion on theoretical basis. To endow SLCA with a sound theoretical model would allow to structure the framework in a consistent whole. So it would allow not only to determine a set of indicators but also to refer to social impacts, thanks to the identification of logical and organized impact pathways. An approach "by capital" forms seems particularly well adapted. It consists in characterizing a process of growth and development as a production system in which multiple capitals are involved (natural, social, human, and produced/physical). It offers the advantage of placing LCA in a theory of development recognized as well adapted to assess sustainable development due to its perennial and exhaustive character (MDDEP 2009).

Many international organizations used this approach (United Nations, OECD, European Economic Comunity, World Bank, UNESCO, EuroStat). In LCA works, this approach has been proposed more or less explicitly. SEEbalance® (Schmidt et al. 2004) covers the four types of "societal" capital: social, human, produced/physical and natural capital. Labuschagne et al. (2006) mention human, productive and community capital. More recently Jorgensen et al. (2010b) suggest that SLCA has to assess changes in human, social and produced/physical capital. Nevertheless, none of these works fully developed this model (notion of flow and stock, positive impacts, pathways, etc.), it's the purpose of our proposition, according to the conclusion of Jorgensen et al. (2010a), confirming the validity of the impact pathways in SLCA. Moreover, until now, four forms of capital have been considered. We propose a broaden approach distinguishing a fifth form, the institutional capital (norms, rules). Actually it depends on social capital (networks) but it has an existence in itself distinct like demonstrated previously.

Until now, SLCA paid attention to characterize and organize social indicators, next step is to articulate them thanks the multiple capital model, in order to reflect social impact and damage or benefit to the AoPs. This would allow to clarify conceptual framework and methodology.

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